19. Create a comprehensive explanation of how quantum statistics are applied to real-world systems.

20. Propose a detailed explanation of how fluctuations are analyzed in statistical mechanics.

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NOVEMBER/DECEMBER 2025

23PPH21 — STATISTICAL MECHANICS

Time : Three hours Maximum : 75 marks

SECTION A — (10 × 2 = 20 marks)

Answer ALL questions.

1. Illustrate the Ehrenfest's classification of phase transitions.

2. What is meant by critical indices in the context of phase transitions?

3. What is Gibb's paradox?

4. Define the Liouville's theorem.

5. What is the significance of the partition function in statistical mechanics?

6. Summarize the role of density fluctuations in the grand canonical ensemble.

7. What is the Planck radiation formula?

8. Classify the differences between classical and quantum statistics.

9. What is the Fokker-Planck equation?

10. Relate the role of fluctuations in transport phenomena.

SECTION B — (5 × 5 = 25 marks)

Answer ALL questions.

11. (a) Explain the implications of the third law of thermodynamics on entropy.

Or

(b) Distinguish the relationship between order parameters and critical phenomena.

12. (a) Organize the role of phase space in statistical mechanics.

Or

(b) Inspect the implications of Gibb' s paradox in statistical mechanics.

13. (a) Compare the differences between canonical and grand canonical ensembles.

Or

(b) Determine how energy fluctuations are calculated in the canonical ensemble.

14. (a) Contrast the significance of Bose-Einstein statistics in quantum mechanics.

Or

(b) Analyze the role of the Planck radiation formula in statistical mechanics.

15. (a) Examine the significance of Brownian motion in statistical physics.

Or

(b) Discover the role of fluctuations in the behavior of real gases.

SECTION C — (3 × 10 = 30 marks)

Answer any THREE questions.

16. Estimate a detailed explanation of how critical indices are used to describe phase transitions.

17. Formulate the connection between microstates, macrostates and entropy.

18. Evaluate the role of the partition function in connecting statistical mechanics and thermodynamics.